REMARKS

Claims 1-19 are all the claims pending in the application. Claims 1-13 and 17-19 are withdrawn from consideration on the basis of an election made by Applicant without traverse. Claims 14 and 16 are allowed. Claim 15 is rejected. Applicants have amended claim 15 to place the claim in independent form.

Claim Rejections - 35 U.S.C. § 102

Claim 15 is rejected under 35 U.S.C. § 102(b) as being anticipated by Steck et al (5,759,908) and Cimalla et al (Materials Science & Engineering publication cited by Applicant in an IDS). This rejection is traversed.

As a preliminary matter, Applicant assumes that the rejection on the basis of the two prior art references is presented in the alternative and not on the basis of their combined teachings. Accordingly, each reference will be considered separately.

The Invention

The invention of claim 15 is directed to a semiconductor device having a silicon carbide deposited layer according to the method of claim 1. The method of claim 1 requires depositing silicon carbide on a substrate from a vapor phase or a liquid phase. More particularly, the method includes depositing a silicon layer on the substrate. Then, the silicon layer is doped with an impurity composed of at least one element selected from a group consisting of N, B, Al, Ga, In, P, As, Sb, Se, Zn, O, Au, V, Er, Ge, and Fe, to form a doped silicon layer. Finally, the doped silicon layer is carbonized into a silicon carbide layer comprising the silicon carbide doped with the impurity. This method of making a silicon carbide layer on a semiconductor substrate, by doping a silicon layer with an impurity and thereafter carbonizing the doped silicon layer, is not found in the prior art references.

Steck et al

Steck et al teaches a method of forming a silicon carbide (SiC) layer by first depositing a silicon (Si) layer on a semiconductor on insulator (SOI) substrate, comprising a SiO_2 layer on a Si substrate, as illustrated in Fig. 1. Step (a). Then, in step (b), the silicon layer is carbonized, as illustrated in Fig. 1(b). There is no teaching at all in Steck et al about carbonizing a doped silicon layer into a silicon carbide layer. Accordingly, the silicon carbide layer claimed in claim 15 is completely different from those disclosed in Steck et al.

Cimalla et al.

As explained at page 171 (Experiments), Cimalla et al begins by using (100)- or (11)-oriented n-type and p-type Si substrates. Cimalla et al performs cleaning steps prior to introducing propane (C_3H_8) as a source of carbon. The carbonization is performed under a constant flow of hydrogen as a carrier gas. There is no deposit of a silicon layer on a substrate, nor is there any doping of that silicon layer, as claimed. The use of a n-type or p-type Si substrate would not anticipate the claimed process nor render it obvious.

Background Art

One known method of doping SiC with an impurity includes a method of growing SiC within an atmosphere of a gas including the impurity. However, this growing method is not satisfactory with regard to the controllability of an impurity concentration in a thickness direction. This is because impurities are arranged or displaced at crystal lattice positions of Si or C and such a displacement ratio is largely varied depending upon a ratio of Si to C (Si/C ratio) in a source material. Thus, such a variation of the Si/C ratio brings about a variation of crystallinity of SiC, a variation in growth speed, and a variation of impurity concentration.

On the other hand, the method according to claim 1 repeatedly carries out a cycle of (1) depositing an undoped silicon layer on a substrate, (2) doping the silicon layer with impurities, and (3) carbonizing the same. With this method, it is possible at every cycle to control the impurity concentration with a independently high resolution, taking into account the thickness of the silicon carbide layer. In this regard, process parameters (such as a doping time and impurity gas concentration) may be precisely controlled, taking into account parameters related to the cystallinity of SiC (Si/C ratio) and the SiC growth speed. The present invention make it possible to obtain the silicon carbide layer that is precisely controlled in impurity concentration and that has a sharp gradient of the impurity.

Moreover, the present invention enables a high-impurity concentration, at a level that exceeds the limitation of solid-solubility in SiC, upto the level in Si.

In short, the semiconductor device having silicon carbide, which is made according to the method now claimed in claim 15, has characteristics that are completely different from and superior to those of Steck et al and Cimalla et al. Therefore, Applicants respectfully submit that

claim 15 is not anticipated by either Steck et al or Cimalla et al, nor is it obvious in view of their teachings and other processes known in the art.

Allowable Subject Matter

Applicant is extremely grateful to the Examiner for the indication that claims 14 and 16 are allowable.

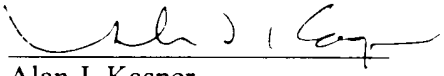
Applicant respectfully submits that claim 15 has clearly been demonstrated to be allowable on the basis of the novel and unobvious steps that are taken from parent claim 1 and now recited in claim 15.

Applicant also respectfully submits that, on the basis of the demonstration herein that claim 1 forms the basis for allowability of claim 15, as the prior art does not teach such method, claim 1 also should be allowable. Those claims that depend from claim 1, namely claims 2-13, also should be allowable. Finally, claims 17-19 also should be allowed, as the two distinguishing steps of claim 1 are recited in these claims. No new search or new issues would be involved in reaching a conclusion that all of claims 1-19 should be allowed.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: September 4, 2002

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

The claims are amended as follows:

15. (Amended) A semiconductor device comprising a silicon carbide layer, said [having the] silicon carbide being manufactured by the method [claimed in claim 1] comprising:

depositing silicon from a vapor phase or a liquid phase onto a substrate and forming a silicon layer on the substrate;

doping the silicon layer with an impurity composed of at least one element selected from a group consisting of N, B, Al, Ga, In, P, As, Sb, Se, Zn, O, Au, V, Er, Ge, and Fe, to form a doped silicon layer; and

carbonizing the doped silicon layer into a silicon carbide layer of the silicon carbide doped with the impurity.